(19) Japan Patent Office

(11) LAID OPEN PATENT APPLICATION
Sho 63 - 268942

(12) Publication of Unexamined Patent (A)

(51) Int. Cl[3]	Classification No.	Int. Control Nos.	(43) Publ. Date: Nov. 7, 1988
F 02 D 23/02		Z-6501-3G	
41/02	335	8011-3G	
F 02 M 69/00	350	K-8311-3G	

Examination Request: Non-request

Number of Inventions: 1

(altogether 6pp)

---

(54) Fuel Injection Device for Supercharged Engine

(21) Patent Application No.: Sho 62-105209
(22) Date Filed: April 28, 1987

(72) INVENTORS:

Name: IWAKI, Masato
Address: Hiroshima-Ken, Aki-gun, Fucho, Shinchi 3 Ban 1 Go
Mazda Corporate Facility

Name: AKAGI, Toshimichi
Address: Hiroshima-Ken, Aki-gun, Fucho, Shinchi 3 Ban 1 Go
Mazda Corporate Facility

Name: KOYAMA, Naoyuki
Address: Hiroshima-Ken, Aki-gun, Fucho, Shinchi 3 Ban 1 Go
Mazda Corporate Facility

(71) Applicant: Mazda Motor Corporation
(72) Agent Attorney: Nakamura, Minoru (and 5 others)

Specification

1. Title of the invention:

Supercharger for a fuel injected engine

2. Scope of patent claims

The fuel injection device of a supercharged engine characterized by the fact that, in a supercharged engine provided with a natural air intake passage which introduces air to the engine through the operation of negative air intake pressure in an air intake process, and in completing the air intake process, in addition to a natural air intake, it is provided with a supercharged passage which introduces air taken in in the operation of the supercharger, and a control valve which opens and closes the supercharger passage, and in the fuel injection device of a supercharged engine minimally provided with a fuel injection valve attached to the supercharger passage, it is composed so as to commence fuel injection from the fuel injection valve attached to the supercharged passage following the closure of the natural fuel intake passage in the open valve period of the control valve.

3. Detailed explanation of the invention

(Industrial applications)

The present invention is concerned with a fuel injected engine, and relates in particular to the fuel injection device of a supercharged engine provided with a fuel injection valve in the supercharging passage.

(Prior art technology)

In a supercharged engine, construction in which a natural air intake passage and a supercharged passage are respectively provided, and in the air intake process, in addition to the intake of natural air, the introduction of supercharged air through a supercharge passage are already known.

For example, Japanese unexamined patent application S 58-20923 discloses a supercharged engine provided with both a natural air passage and a supercharge passage, in which a fuel injection valve is attached in the supercharged passage, and fuel is injected into the supercharged air during the supercharging period.

By this means, with this device, there is improved aerification and exposure of the fuel.

(Problems overcome by the invention)

However, with this disclosed device, since the injection of fuel to the supercharged passage commences prior to the closure of the natural air intake passage, there is the phenomenon that part of a supercharged air mixture having high-pressure will be drawn into the natural air passage, after which the natural air intake passage is closed. As a result, in the air intake passage part of the fuel which should be injected remains within the natural air intake passage without being introduced to the fuel chamber, and is introduced into the fuel chamber after the air intake process.

Furthermore, with this device, there is the problem that specified fuel injection control or air fuel ratio control will not be achieved.

(Problem resolution means)

The present invention was constructed with due consideration to these problems, and prevents the withdrawal of the supercharged air into the natural air intake passage from the supercharged passage, as described above, and has as its objective the providing of a fuel injection device of a supercharged engine capable of appropriately controlling the air/fuel ratio.

The present invention is a fuel injection device for a supercharged engine wherein, in a natural air intake passage, and following the air intake process which introduces air taken in to the engine by the operation of negative air intake pressure in the air intake process, in addition to the natural air, it is provided with:
a supercharge passage which introduces air taken in through the operation of a supercharge, and
a control valve which opens and closes the supercharge passage, and at least a fuel injection valve attached to the supercharge passage.

Also, in the device according to the present invention, in the open period of the control valve and following the closure of the natural air intake passage, fuel injection commences from the fuel injection valve attached to the supercharge passage.

Efficacy of the invention

According to the present invention, since fuel injection in the supercharge passage commences after the natural air passage is closed, removal to the natural air passage of supercharged air can be prevented, and appropriate fuel injection control, in other words air/fuel ratio control, can be accomplished.

Explanation of embodiment.

An explanation of the first embodiment of the invention is provided hereafter, with reference to the drawings.

Figure 1 shows a summary of the engine relating to the first embodiment of the present invention.

Engine 1 in the present example is a rotary piston engine, which is provided with a rotary housing 3 which houses a triangular rotary piston in a manner in which it can freely rotate.

The rotary piston 2 is supported by the eccentric axis 4, and rotates while making rubbing contact with a peripheral wall 5a by means of an apex seal, and a fixed wall 5b forming part of an internal air space 5 of a rotary housing by means of a side seal.

The engine's air intake system is respectively provided with an air cleaner 7 at the uppermost flow of the air intake passage 6, and an air flow meter 8 at its lower flow.

The air intake passage 6 is divided into a natural air intake passage 9 and a supercharge passage 10 at the lower flow of the air flow meter 8, and the natural air intake passage 9 is further divided in the lower flow into a first natural air intake passage 9a and a 2nd natural air intake passage 9b.

Throttle valves 9a and 9b are respectively attached to the natural air intake passages 9a and 9b.

Also, the natural air intake passages 9a and 9b respectively communicate with natural air intake ports 12 (only 1 is shown) which open to the side wall 5b which faces the rotary housing.

In addition, a first injector 13 is attached in the vicinity of the rotary housing 3 internal air space 5 of the first natural air intake passage 9a.

To the supercharge passage 10 is attached a (Rubbler – phonetic) supercharger 14 , and to the lower and to the lower flow of the supercharger 14 is attached an inter-cooler 15.

To the lower flow of the intercooler 15 is attached a relief passage 16 which returns a part of the supercharged air to the upper flow of the supercharger 14, and to the relief passage 17 is attached a relief valve 18 for controlling the amount of returned supercharged air.

Further, on the lower flow of the supercharge passage 10 is arranged a supercharge throttle valve 19 which is linked to the throttle valve 11a of the natural air intake passage 9a.

Also, to the lower flow is further attached a rotary valve 20 which opens and closes the supercharge passage 10.

Supercharge passage 10 communicates with supercharge port 21 which opens to the sidewall 5b of the air space 5 within the rotor housing 3.

In addition, to the lower flow of the rotary valve is attached a second injector which injects fuel to the supercharged air within the supercharge passage.

The engine fuel system is provided with a fuel tank 23, with the fuel being supplied from the fuel tank 23 through a fuel pump 24 and a fuel filter 25, by means of fuel supply passage 26 to the first injector 13 and the second injector 25.

The fuel injector is adjusted by a regulator 27, and excess fuel is returned to the fuel tank 23 through the fuel return passage 28.

In addition, in the peripheral wall 5a of the inside air space 5 is opened an exhaust port 29, which communicates with exhaust passage 30. To the lower flow of the exhaust passage 30 is attached a catalytic converter 31.

The engine crank angle is established to be detected by the crank angle sensor 32 attached to the eccentric axis 4.

In addition, the engine coolant temperature is detected by the coolant temperature sensor 33.

Furthermore, the degree of opening of the throttle valve 11a is established to be detected by the throttle degree of opening sensor 34.

With the device of the present example, an electronic control unit is desirably provided in the form of a micro-computer in order to accomplish each type of control.

In control unit 35, a signal is input from crank angle sensor 32, coolant temperature 33, throttle angle degree of opening sensor 34 and air flow meter 8.

Control unit 35 calculates the input signals and outputs a specific control signal relative to relief valve 18 or the first or second injectors 13 and 22.

An explanation is provided next of controlling the amount of fuel injection to the engine, with reference to Figure 2.

In Figure 2, control unit 35 reads (in step S1) the amount of air intake (Oa).

In addition, the engine rpm (Ne) is read (in step S2) based on a signal from the crank angle sensor 32.

Next, the base fuel injection time Tb is calculated (in step S3) based of these data.

Furthermore, the control unit 35 inputs (in step S4 and S5) data relating to the temperature of the coolant and the battery.

Next, the control unit 35 considers data, such as for example the injection increase correction coefficient Cw and the invalid injection time Tba corresponding to the battery voltage, and calculates the fuel injection time.

Also, a determination is made (in step S7) by the control unit 35 as to whether the degree of opening of the throttle valve 11a exceeds a specified value, in which case the supercharge throttle valve 19 links to the throttle valve 11a, and begins to open the throttle valve 11 a specified amount.

Furthermore, by detecting the degree of opening of throttle valve 11a, a determination can be made as to whether the supercharge passage 10 is in the open, or supercharge state.

If the supercharged state has been reached, the control unit 35 reads (in step S8) the data from the crank angle sensor 32.

Also, in terms of the crank angle, a determination is made as to whether the first injector 13 used for natural air intake and the 2nd injector 22 used for

supercharged air supply have reached the injection period, and injection control is accomplished with specified timing.

In this case, the period in which the natural air intake port is open and the period in which the rotary valve 20 are open are as shown in Figure 3.

In other words, the rotary valve 20 is established to open before closing the natural air intake port.

However, if the injection from the 2nd injector starts prior to closing the natural air intake port 12, a part of the high pressure super charged air will be drawn into the natural air intake passage 9a and 9b, and a portion of the fuel which should be injected will not be introduced into the combustion chamber.

Furthermore, the injection capable period of the injector 13 and the injection capable period of the 2nd injector respectively fall within the parameters shown by the inclined line of Figure 3, within which there is a need to exercise control to accomplish the fuel injection.

Owing to this, control unit 35 determines (in step S9) whether it is an injection capable period for the first injector 13 based on the data from the crank angle sensor read in step (in step S8).

If the determination is YES, the control unit 35 calculates (in step S10) the injection time TI of the first injector 13.

In this case, the injection time of the first injector 13 of the present example is established at half the injection time of the entire body.

Also, a fuel injection command is generated (in step S11) relative to the first injector 13.

In addition, in step (in step S9), in the case where it is not possible to accomplish injection with a first injector 13, a determination is made (in step S12, S13) as to whether the natural air intake valve 12 is closed, and whether the rotary valve 20 is open. If the answer in both cases is YES, then it is determined to be a period in which is possible to accomplish injection through the second injector 22, and the injection time is calculated (in step S14) of the second injector 22. In this case, in this example the same length is established as that of the injection time of the first injector 13. Also, a drive command is generated (in step S15) for the second injector 22. By accomplishing control such as that indicated above, blown removal of air to the natural air intake

passage of supercharged mixed air is prevented, and control is accomplished over the desired fuel supply. Moreover, in this example, an explanation has been provided concerning an example applied to the rotary piston engine of the present invention. However, application may also be applied in the same manner relative to a reciprocal engine.

4. Brief explanation of drawings

Figure 1 is a summary compositional diagram of a rotary piston engine relating to the first embodiment of present invention. Figure 2 is a flowchart of fuel supply control relating to the first embodiment of the present invention. 3 is a graph which shows the relationship between the period in which the natural air intake port is closed, and the period in which the rotary valve is open.

1: engine
2: rotary piston
3: rotary housing
4: eccentric axis
5: internal air temperature
6: air intake passage
7: air cleaner
8: air flow meter
9: natural air intake passage
10: supercharged passage
11a, 11 b: throttle valve
12: natural air intake port
13: first injector
14: supercharger
15: intercooler
16: relief passage
17: relief passage
18: relief valve
19: supercharged throttle valve
20: rotary valve
21: supercharged port
22: second injector
23: fuel tank
24: fuel pump
25: fuel filter
26: fuel supply passage
27: pressure regulator
28: return passage

29: exhaust port
30: exhaust passage
31: catalytic converter
32: crank angle sensor
33: water temperature sensor
34: degree of throttle opening sensor
35: control unit